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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/602,194	06/23/2003	Yoshi Ono	SLA 0669	9996

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EXAMINER	
NGUYEN, KHIEM D	

ART UNIT	PAPER NUMBER
2823	

DATE MAILED: 08/08/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/602,194	ONO, YOSHI	
	Examiner	Art Unit	
	Khiem D. Nguyen	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *06 April 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-5,7-11 and 13-22* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5,7-11 and 13-22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *23 June 2006* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Applicant's Amendment and Arguments

1. The final rejection as set forth in paper No. (010606) mailed on January 10th, 2006 is withdrawn in response to applicant's persuasive arguments in the pre-appeal brief request for review submitted on April 6th, 2006. A new rejection is made as set forth in this Office Action. Claims (1-5, 7-11 and 13-22) are pending in the application.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-5, 7-11 and 13-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kakkad (U.S. Patent 6,610,613) in view of Kawakami et al. (U.S. Patent 6,470,824).

In re claim 1, **Kakkad** discloses a method of low-temperature nitridation of a silicon substrate comprising:

placing a silicon wafer (WAFER) in a vacuum chamber on a heated chuck (col. 2, lines 37-41);

maintaining the silicon wafer at a temperature of between about 20 to 700 °C (col. 4, lines 12-14);

introducing a nitrogen-containing gas into the vacuum chamber, wherein the nitrogen-containing gas is taken form the group of gases consisting of NH_3 (col. 2, lines 63-66);

dissociating the nitrogen-containing gas into nitrogen with a xenon excimer lamp (UV LAMP), and flowing the nitrogen over the silicon wafer (col. 2, line 64 to col. 3, line 5). Note that the xenon excimer lamp as taught by Kakkad inherently operating at a wavelength of 172 nm to flow the nitrogen over the silicon wafer; and

growing a silicon nitride layer on at least a portion of the silicon wafer, wherein the silicon nitride layer is formed from silicon in the silicon wafer and nitrogen from the dissociated nitrogen-containing gas (col. 3, line 65 to col. 4, line 4 and FIG. 1).

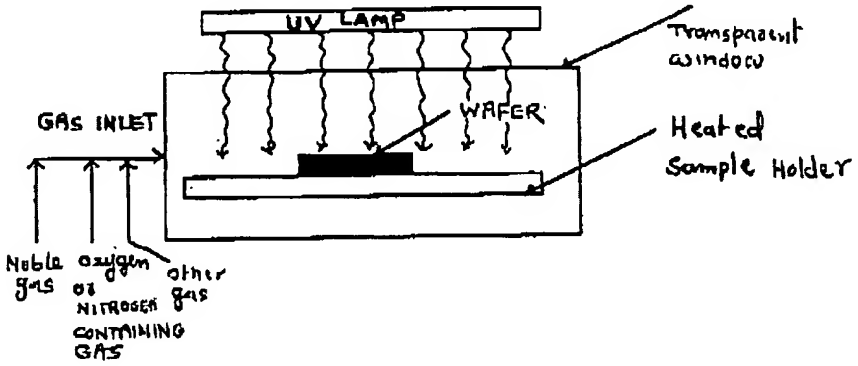


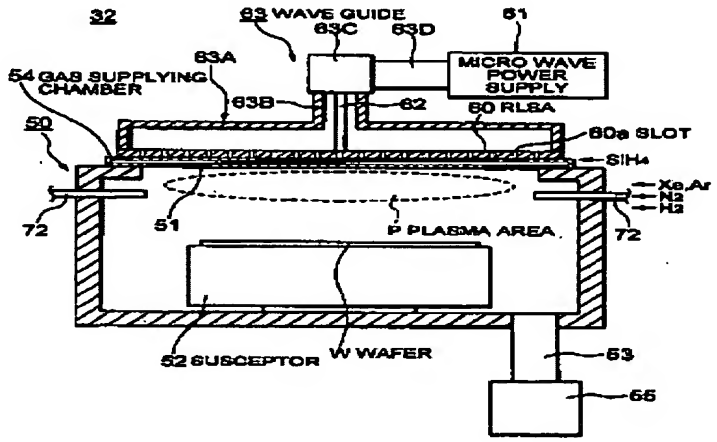
FIGURE 1

Kakkad discloses introducing a nitrogen-containing gas into the vacuum chamber wherein the nitrogen-containing gas is taken from the group of gases consisting of NH_3 in order to grow a silicon nitride layer on at least a portion of the silicon wafer (col. 2, lines 64 to col. 3, line 5) but does not explicitly discloses growing a silicon nitride layer that has a thickness of less than 5 nm as recited in independent claim 1.

Kawakami, however, discloses a process of low-temperature nitridation of a silicon substrate comprising placing a silicon wafer W in a vacuum chamber 32, maintaining the silicon wafer W at a temperature of 400 °C and introducing a nitrogen-

containing gas (N_2) into the vacuum chamber to grow a silicon nitride layer on at least a portion of the silicon wafer wherein the silicon nitride layer has a thickness of 4 nm (col. 9, lines 22-55 and FIG. 3).

FIG. 3



Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to combine the teaching of Kakka and Kawakami to enable the process of growing a silicon nitride layer having a thickness of less than 5 nm of Kakka to be performed and furthermore to provide a method for manufacturing semiconductors that can form a SiN film of high quality in a short time (col. 2, lines 29-32, Kawakami).

In re claim 2, as applied to claim 1 above, Kakka in combination with Kawakami discloses all claimed limitations including the limitation wherein the method further includes maintaining the vacuum chamber at a pressure of between about 50 mTorr to about 1 Torr (col. 9, lines 27-28, Kawakami).

In re claim 3 as applied to claim 1 above, Kakka in combination with Kawakami discloses all claimed limitations including the limitation wherein introducing the

nitrogen-containing gas in the vacuum chamber includes providing a gas flow rate of about 20 sccm (col. 9, lines 30-35, Kawakami).

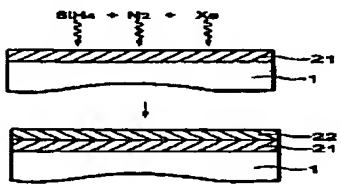
In re claim 4, as applied to claim 1 above, Kakka in combination with Kawakami discloses all claimed limitations including the limitation wherein maintaining includes maintaining the wafer in the vacuum chamber in contact with nitrogen for about 30 seconds (col. 9, lines 40-44, Kawakami).

In re claim 5, as applied to claim 1 above, Kakka in combination with Kawakami discloses all claimed limitations including the limitation wherein forming a silicon nitride layer on a silicon wafer in a time period of about 30 seconds (col. 9, lines 40-44, Kawakami).

In re claim 7, as applied to claim 1 above, Kakka in combination with Kawakami discloses all claimed limitations including the limitation wherein forming includes providing a positively charged interface across the nitride layer (col. 2, lines 64 to col. 3, line 2, Kakka).

In re claim 8, as applied to claim 1 above, Kakka in combination with Kawakami discloses all claimed limitations including the limitation wherein placing a silicon wafer having a layer of silicon oxide on the upper surface thereof in a vacuum chamber (col. 9, lines 35-44 and FIG. 7B, Kawakami).

FIG. 7B



In re claim 9, **Kakkad** discloses a method of low-temperature nitridation of a silicon substrate comprising:

placing a silicon wafer (WAFER) in a vacuum chamber on a heated chuck (col. 2, lines 37-41);

maintaining the silicon wafer **6** at a temperature of between about 20 to 700 °C (col. 4, lines 12-14);

introducing a nitrogen-containing gas into the vacuum chamber, wherein the nitrogen-containing gas is taken form the group of gases consisting of NH_3 (col. 2, lines 63-66);

dissociating the nitrogen-containing gas into nitrogen with a xenon excimer lamp (UV LAMP), and flowing the nitrogen over the silicon wafer (col. 2, line 64 to col. 3, line 5). Note that the xenon excimer lamp as taught by Kakkad inherently operating at a wavelength of 172 nm to flow the nitrogen over the silicon wafer; and

growing a silicon nitride layer on at least a portion of the silicon wafer, wherein the silicon nitride layer is formed from silicon in the silicon wafer and nitrogen from the dissociated nitrogen-containing gas (col. 3, line 65 to col. 4, line 4 and FIG. 1).

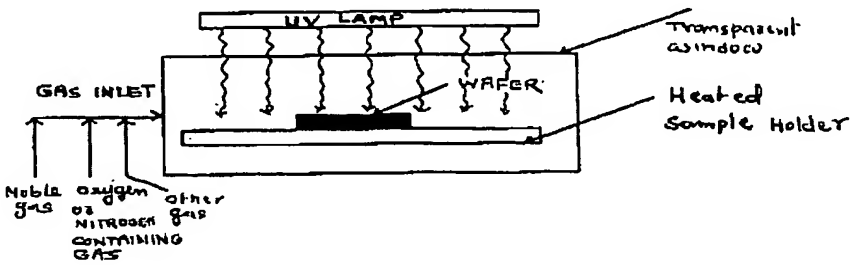
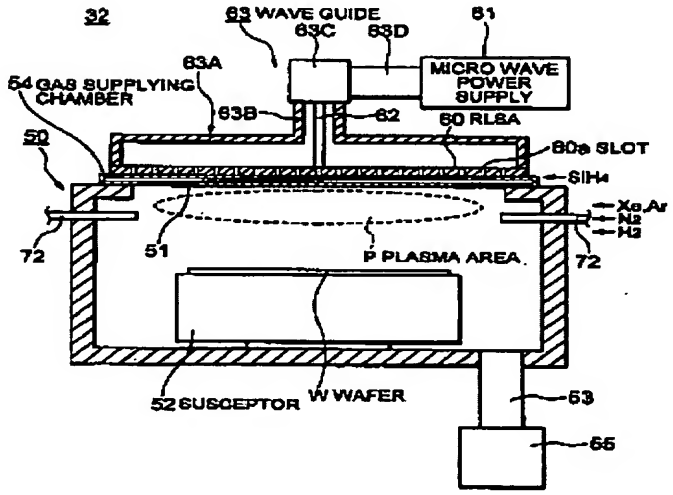


FIGURE 1

Kakkad discloses introducing a nitrogen-containing gas into the vacuum chamber wherein the nitrogen-containing gas is taken from the group of gases consisting of NH_3 in order to grow a silicon nitride layer on at least a portion of the silicon wafer (col. 2, lines 64 to col. 3, line 5) but does not explicitly discloses growing a silicon nitride layer that has a thickness of less than 5 nm at a pressure of less than 200 mTorr as recited in independent claim 9.

Kawakami, however, discloses a process of low-temperature nitridation of a silicon substrate comprising placing a silicon wafer W in a vacuum chamber 32, maintaining the silicon wafer W at a temperature of 400 °C and introducing a nitrogen-containing gas (N_2) into the vacuum chamber to grow a silicon nitride layer on at least a portion of the silicon wafer wherein the silicon nitride layer has a thickness of 4 nm (col. 9, lines 22-55 and FIG. 3) and wherein maintaining the vacuum chamber at a pressure of between about 50 mTorr to about 1 Torr (col. 9, lines 27-28, Kawakami).

FIG. 3



Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to combine the teaching of Kakka and Kawakami to enable the process of growing a silicon nitride layer having a thickness of less than 5 nm of Kakka to be performed and furthermore to provide a method for manufacturing semiconductors that can form a SiN film of high quality in a short time (col. 2, lines 29-32, Kawakami).

In re claim 10, as applied to claim 9 above, Kakka in combination with Kawakami discloses all claimed limitations including the limitation wherein forming a silicon nitride layer on a silicon wafer in a time period of about 30 seconds (col. 9, lines 40-44, Kawakami).

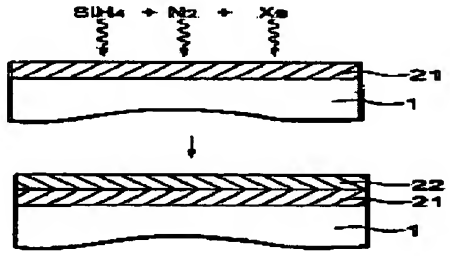
In re claim 11, as applied to claim 9 above, Kakka in combination with Kawakami discloses all claimed limitations including the limitation wherein maintaining includes maintaining the wafer in the vacuum chamber in contact with nitrogen for about 30 seconds (col. 9, lines 40-44, Kawakami).

In re claim 13 as applied to claim 9 above, Kakka in combination with Kawakami discloses all claimed limitations including the limitation wherein introducing the nitrogen-containing gas in the vacuum chamber includes providing a gas flow rate of about 20 sccm (col. 9, lines 30-35, Kawakami).

In re claim 14, as applied to claim 9 above, Kakka in combination with Kawakami discloses all claimed limitations including the limitation wherein forming includes providing a positively charged interface across the nitride layer (col. 2, lines 64 to col. 3, line 2, Kakka).

In re claim 15, as applied to claim 9 above, Kakka in combination with Kawakami discloses all claimed limitations including the limitation wherein placing a silicon wafer having a layer of silicon oxide on the upper surface thereof in a vacuum chamber (col. 9, lines 35-44 and FIG. 7B, Kawakami).

FIG. 7B



In re claim 16, **Kakkad** discloses a method of low-temperature nitridation of a silicon substrate comprising:

placing a silicon wafer (WAFER) in a vacuum chamber on a heated chuck (col. 2, lines 37-41);

maintaining the silicon wafer at a temperature of between about 20 to 700 °C (col. 4, lines 12-14);

providing a positively charged interface across the nitride layer (col. 2, lines 64 to col. 3, line 2).

introducing a nitrogen-containing gas into the vacuum chamber, wherein the nitrogen-containing gas is taken form the group of gases consisting of NH_3 (col. 2, lines 63-66);

dissociating the nitrogen-containing gas into nitrogen with a xenon excimer lamp (UV LAMP), and flowing the nitrogen over the silicon wafer (col. 2, line 64 to col. 3, line

5). Note that the xenon excimer lamp as taught by Kakkad inherently operating at a wavelength of 172 nm to flow the nitrogen over the silicon wafer; and

growing a silicon nitride layer on at least a portion of the silicon wafer, wherein the silicon nitride layer is formed from silicon in the silicon wafer and nitrogen from the dissociated nitrogen-containing gas (col. 3, line 65 to col. 4, line 4 and FIG. 1).

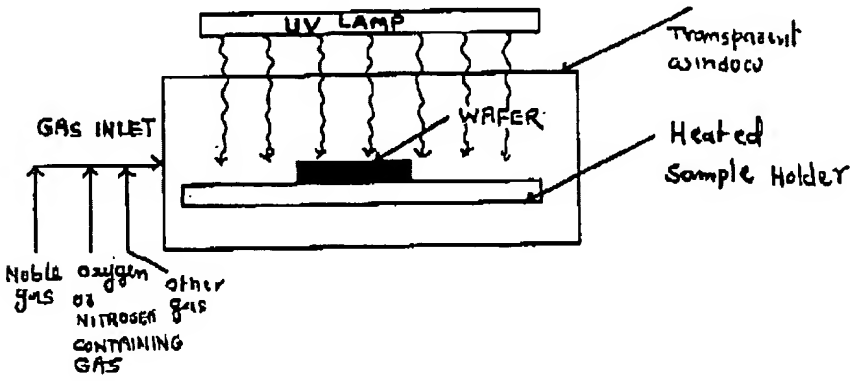


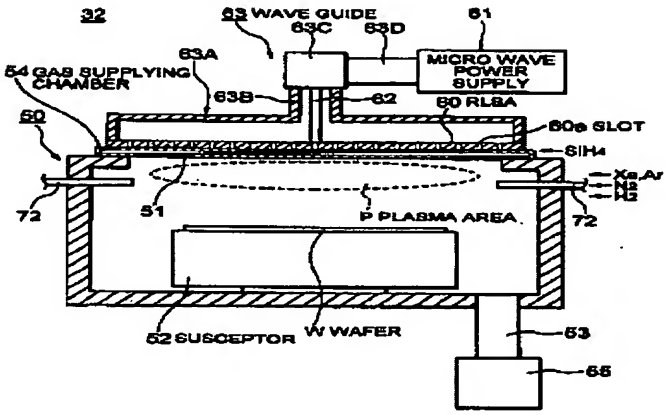
FIGURE 1

Kakkad discloses introducing a nitrogen-containing gas into the vacuum chamber wherein the nitrogen-containing gas is taken from the group of gases consisting of NH_3 in order to grow a silicon nitride layer on at least a portion of the silicon wafer (col. 2, lines 64 to col. 3, line 5) but does not explicitly discloses growing a silicon nitride layer that has a thickness of less than 5 nm as recited in independent claim 16.

Kawakami, however, discloses a process of low-temperature nitridation of a silicon substrate comprising placing a silicon wafer W in a vacuum chamber 32, maintaining the silicon wafer W at a temperature of 400 °C and introducing a nitrogen-containing gas (N_2) into the vacuum chamber to grow a silicon nitride layer on at least a

portion of the silicon wafer wherein the silicon nitride layer has a thickness of 4 nm (col. 9, lines 22-55 and FIG. 3).

FIG. 3



Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to combine the teaching of Kakka and Kawakami to enable the process of growing a silicon nitride layer having a thickness of less than 5 nm of Kakka to be performed and furthermore to provide a method for manufacturing semiconductors that can form a SiN film of high quality in a short time (col. 2, lines 29-32, Kawakami).

In re claim 17, as applied to claim 16 above, Kakka in combination with Kawakami discloses all claimed limitations including the limitation wherein the nitrogen-containing gas is taken form the group of gases consisting of NH_3 (col. 2, lines 63-66, Kakka).

In re claim 18, as applied to claim 16 above, Kakka in combination with Kawakami discloses all claimed limitations including the limitation wherein the method

further includes maintaining the vacuum chamber at a pressure of between about 50 mTorr to about 1 Torr (col. 9, lines 27-28, Kawakami).

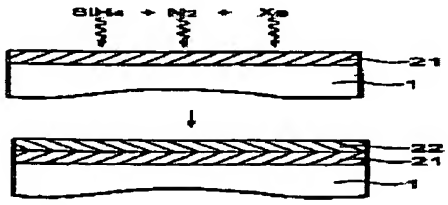
In re claim 19, as applied to claim 16 above, Kakka in combination with Kawakami discloses all claimed limitations including the limitation wherein forming a silicon nitride layer on a silicon wafer in a time period of about 30 seconds (col. 9, lines 40-44, Kawakami).

In re claim 20, as applied to claim 16 above, Kakka in combination with Kawakami discloses all claimed limitations including the limitation wherein maintaining includes maintaining the wafer in the vacuum chamber in contact with nitrogen for about 30 seconds (col. 9, lines 40-44, Kawakami).

In re claim 21 as applied to claim 16 above, Kakka in combination with Kawakami discloses all claimed limitations including the limitation wherein introducing the nitrogen-containing gas in the vacuum chamber includes providing a gas flow rate of about 20 sccm (col. 9, lines 30-35, Kawakami).

In re claim 22, as applied to claim 16 above, Kakka in combination with Kawakami discloses all claimed limitations including the limitation wherein placing a silicon wafer having a layer of silicon oxide on the upper surface thereof in a vacuum chamber (col. 9, lines 35-44 and FIG. 7B, Kawakami).

FIG. 7B



Response to Applicant's Arguments

4. Applicant's arguments, see page 1 of the pre-appeal brief request for review, filed April 06th, 2006, with respect to the rejection(s) of claim(s) 1-5, 7-11 and 13-22 under 35 U.S.C. 103(a) have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of Kakkad (U.S. Patent 6,610,613) in combination with Kawakami et al. (U.S. Patent 6,470,824) as described above in Paragraph 3 presented in this Office Action.

Conclusion

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Khiem D. Nguyen whose telephone number is (571) 272-1865. The examiner can normally be reached on Monday-Friday (8:30 AM - 5:30 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew S. Smith can be reached on (571) 272-1907. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

K.N.
August 01, 2006

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